MARK IV MONORAIL

Community Transportation Services

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Four Generations of Monorail Systems

DISNEYLAND opened in 1955 with an exposition of transportation systems, from double-decker buses to riverboats. Already a mini-city in transportation activity, DISNEYLAND inaugurated the first daily monorail service in 1959. The design and development of the monorail system reflected Walt Disney's personal commitment to not only build an attraction, but more importantly, to provide a transportation system for the future.

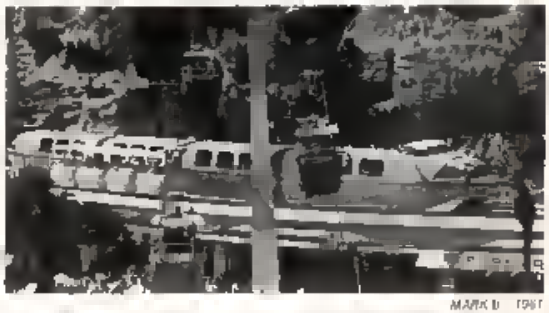
In 1961, with increasing transportation needs, the monorail system was expanded to include the Disneyland Hotel. At the same time, three new MARK II trains were introduced, each having four cars. Operating now on 2.5 miles of beamway, with two stations, the MARK II was the first monorail to run adjacent to a major highway and cross city streets.

As the demand for additional capacity grew, so did the monorail system. In 1969, four new MARK III five-car monorails were unveiled demonstrating Disney's true dedication to stay at the forefront of technology.

Then with the opening in 1971 of the WALT DISNEY WORLD Destination Resort in Florida, the Disney organization revealed a new monorail system as the primary transportation link between the resort hotels, main parking area, and the Magic Kingdom. The economic viability of the entire WALT DISNEY WORLD Resort Area is hinged on the performance and reliability of the MARK IV Monorail System. This expression of confidence in the MARK IV monorail was made possible through the many years of experience Disney accumulated since inaugurating the first MARK I in 1959. The MARK IV Monorail carries over 25 million passengers a year with a sustained reliability record of over 99.9%.

As a part of the Experimental Prototype Community of Tomorrow now under development in Florida, Community Transportation Services will develop the transportation systems and technologies to be showcased to the public in a continuing effort to provide clean, efficient transportation to cities throughout the world. Community Transportation Services represents two decades of research, development, construction, testing, and operation of transportation systems — systems that not only provide solutions to Walt Disney Productions' needs, but also provide solutions to the transportation needs of today's cities.

MARK I – 1959



MARK II – 1961

MARK III – 1969

MARK IV – 1971

MARK IV Monorail System Overview

The MARK IV Monorail System at the WALT DISNEY WORLD Vacation Kingdom is one of the most advanced time-proven technologies in operation anywhere in the world. In eight years of daily passenger service, the 10 MARK IV trains have logged over 4 million miles and carried some 200 million passengers. The silent-running, all-electric trains combine luxury with outstanding achievements in engineering and operate at one-fourth (1,000 Btu's per passenger mile) of the energy required for commuting automobiles.

Operating on a 26-inch-wide beam the WALT DISNEY WORLD Monorail guideway features an elevated double-loop configuration. An additional seven-tenths of a mile is utilized as a spur line connecting the main concourse to the "roundhouse." Tapered precast concrete columns support prestressed post-tensioned sections of beamway up to 60 feet above the terrain for spans up to 110 feet. Passing directly through the fourth floor of the Contemporary Resort Hotel the monorail can serve 10,000 seated passengers an hour. Stations serving main transportation hubs utilize the 'through loading' capability of the MARK IV's paired doors on alternate sides of the train. This type of loading/off loading can reduce station dwell times by 50% when compared with a single-sided operation. Seatings is provided for all passengers, and the traditional 'crush loading' is an experience that has been eliminated by the operational configuration of the train. Provisions for handicapped persons are available on the MARK IV series monorail.

Advanced designs and easy-access maintenance have proven to be key factors in the MARK IV's 99.9% operational readiness record accumulated over the past eight years. With total operating costs remaining below $.06 per passenger mile during 1979, the WALT DISNEY WORLD MARK IV Monorail System is unsurpassed in transportation economy and reliability.

The 6.7 mile MARK IV Monorail system at the WALT DISNEY WORLD Vacation Kingdom

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Trains

The five- and six-car MARK IV trains at the WALT DISNEY WORLD Resort Complex incorporate the latest proven designs and technology derived from over 20 years of daily monorail operating experience. Each six-car monorail is 201 feet long, weighs 50 tons empty, and carries 250 passengers in total air-conditioned comfort. Each train has twelve 18-ply pneumatic load tires to provide propulsion and braking from eight 100 hp, 600-volt, DC electric motors/dynamos. There is also an 18-inch mechanical disk brake on each load tire, but the mechanical system generally accounts for less than one-fourth of the braking required in normal operation.

Foam-filled side tires in lateral contact with the beamway guide the monorail chassis. The coaches are suspended over each load tire on air beg cushions, which are automatically inflated or deflated to correct for varying load conditions.

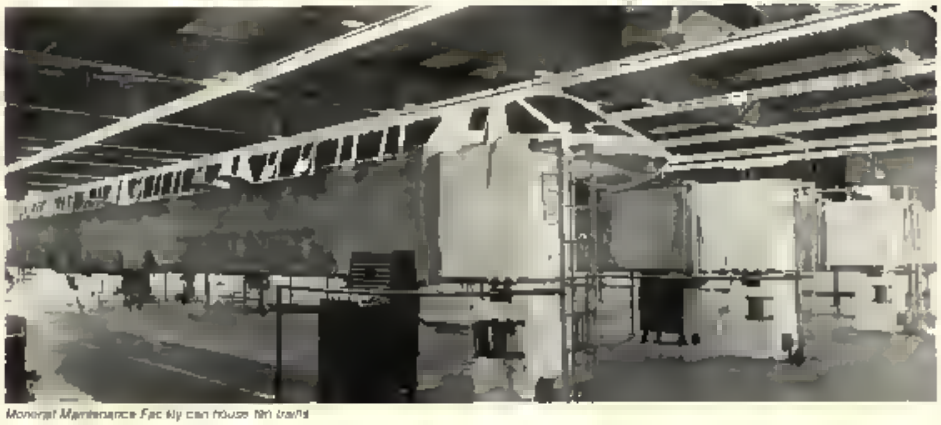
Passengers board through five air-actuated doors on either side of the train. Disabled passengers may be accommodated through a special wide access door on each train. Automatic sliding doors are also available.

Hand-built grey seats

Power for the monorail is picked up by eight carbon collectors in contact with a 600-volt buss bar below the train. Safety interlocks in the driver's console preclude operation of a train without all doors secured. The operator can then select one of four forward speed settings, a neutral, or three braking positions. Acceleration and deceleration is accomplished from the operator's selected setting by automatically stepping through 15 power increments or 10 braking selections. Maximum acceleration is 0.7 fps², and deceleration is 3 fps². MARK IV Monorail trains can be operated in either direction.

Maintenance activities are performed in the monorail 'roundhouse' where each train is given a daily check. Side compartments give easy access to most moving components of the MARK IV train, and permit visual inspection of the train's main support systems in a matter of minutes. In operation for over eight years, the MARK IV trains have maintained an impressive reliability record of 99.9% for their 800 million passenger seat miles traveled — that's enough seating capacity to transport every individual in the United States three miles.

Main Load Line



Monorail Maintenance Facility can house ten trains

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Beamway

Heights to 85 feet

The nearly 35,000 feet of beamway at the WALT DISNEY WORLD Resort Complex represents the state of the art in structural designs and material technology. The Disney design features long span, prestressed, post-tensioned beams with curved haunches, precast columns and cast-in-place substructure — a combination that creates a technically exciting and highly functional structure. Close attention to tolerances for riding comfort, smooth geometry and few disruptive discontinuities provide an aesthetically pleasing structure totally compatible with its surroundings. Tapered precast concrete columns support the monorail beamway to a maximum height of 85 feet. The 26-inch-wide prestressed girders are typically 90 to 110 feet in length; midspan depths are 48 inches, and at the ends of parabolic haunches they are 80 inches in depth. The 337

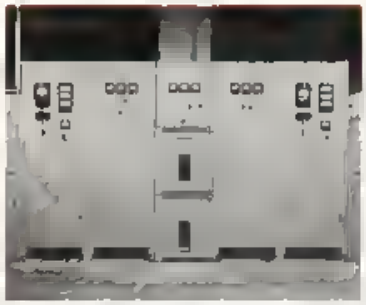
26 in. n wide by variable

Spans to 110 feet

beams were cast with a hollow center core to keep weights under 50 tons. Approximately half of the girders have some combination of vertical and horizontal curvatures and variable super elevation. Accurate prestressing insures zero camber for the guideway girders. Once in place, post-tensioning allows final alignment of segments of the beamway to reduce any remaining discontinuities.

The beamway provides electrical power to the trains through a 600-volt DC buss bar affixed to the lower sides of each beam. The buss bar is fed from four separate power rectifier stations along the beamway.

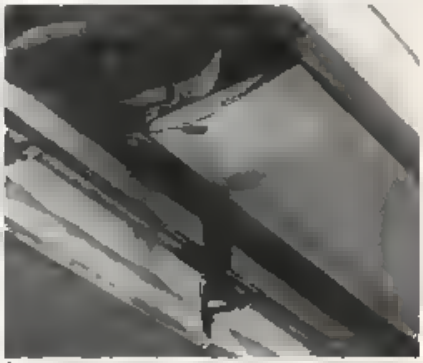
Switching is accomplished by hinged segments of beamway which select alternate routings upon command from a central monitoring point. Lock-to-lock time is approximately 50 seconds and train speed is reduced in the switch.



Rectifier Station Equipment

Rectifier Station below beamway

Monorail Switches



Buss bar and collector shoes

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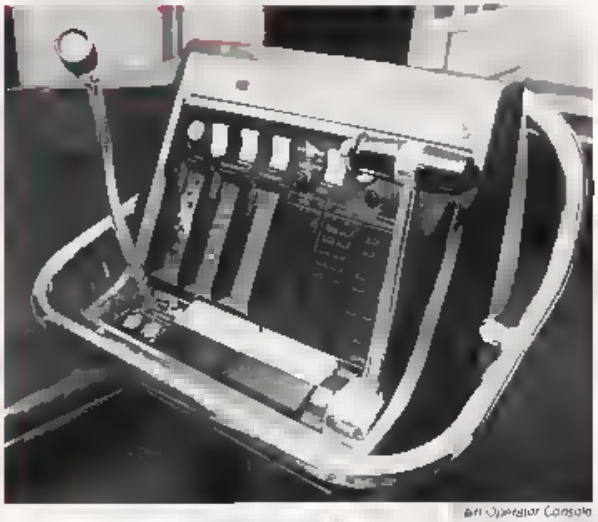
Control System

Train Subsystem Monitor Panel



BART Operator Console

Three separate control systems monitor train separation. The first and most important is the operator's visual surveillance of the beamway. Second, a conventional block light system is made up of magnetic reed switches which activate either red-green or red-amber signals. Should an operator inadvertently pass a red stop signal, the third backup electronic detection system will automatically drop power from the drive motors and apply braking until the train is completely stopped.

Communications with each train operator is maintained via radio. Train-to-train, train-to-maintenance, and train-to-station communication allows additional control and safety should all other systems be inoperative. The operator can announce upcoming stations and other operating information to passengers over the train's onboard public address system.

Speed is controlled by the operator's selection of one of several preset speeds. The electric-traction motors are automatically stepped through power increments until the selected speed is reached. Braking rates are input by operator controls to provide smooth deceleration using both dynamic and mechanical braking systems.

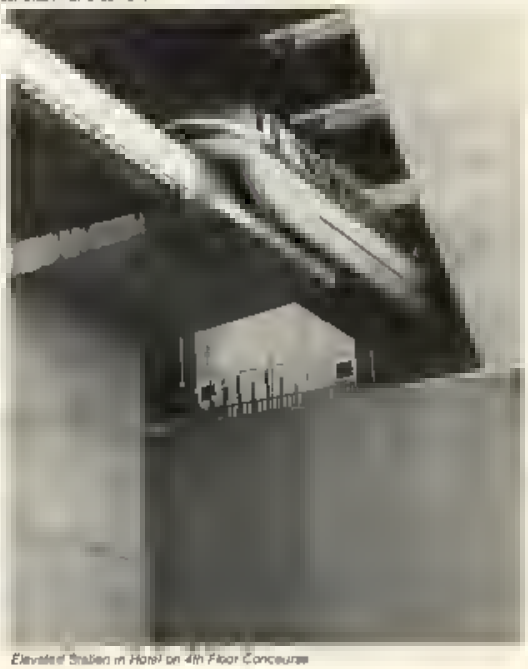
Safety interlocks prevent any train motion without all necessary doors and other devices positioned for travel.

Station attendants in Radio Contact with Train Operators

Stations

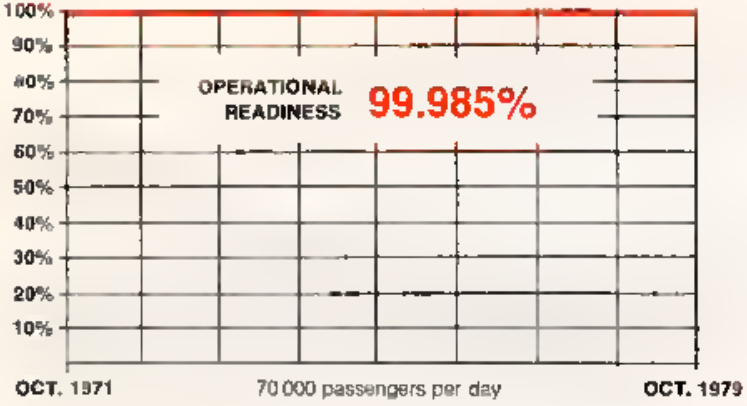
Four monorail stations serve the WALT DISNEY WORLD resort hotels, visitor parking lots and the theme park area. Two stations are above grade and two stations are on grade. All four stations are designed for dual beam operation and the high volume traffic of the theme park and transportation center stations which utilize the unique 'through-loading' capability of the MARK IV trains. With trains arriving from both directions every two minutes, station attendants stage passengers in chutes for quick loading. The loading chutes permit car and seat selection prior to train arrival and reduce loading confusion once the train is in the station. Inbound passengers arriving on the train exit from the opposite side of the train and are routed down an exit ramp without intermingling with outbound passengers.

Main Transportation Center Station at Grade Level



Elevated Station in Hotel on 4th Floor Concourse

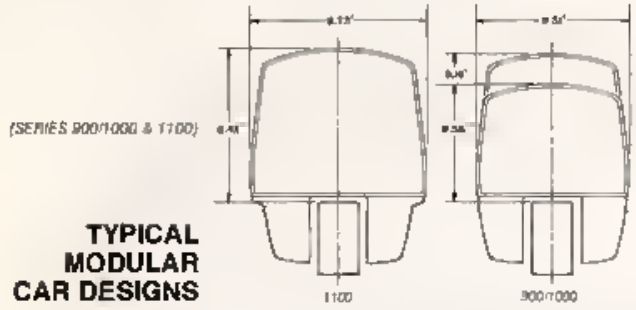
Operations



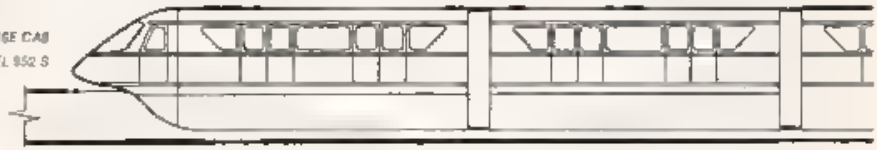
The WALT DISNEY WORLD MARK IV Monorail System is the most heavily traveled passenger monorail in the world. With over four million train-miles accumulated since 1971, the MARK IV Monorail has transported an average of 70 thousand passengers a day, 365 days a year. This service level has been maintained with a system reliability of 99.9%, and operating costs below $.06 per passenger mile in 1979.

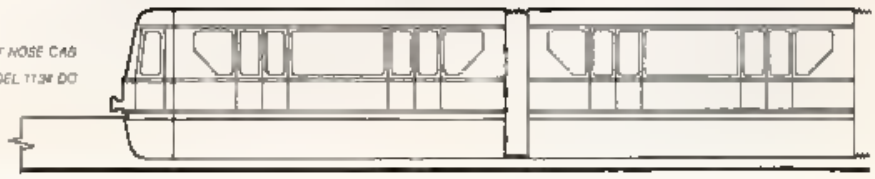
Station attendants stage passengers for boarding prior to train arrival to insure minimal delays. Train operators provide enroute briefings to passengers on operating schedules, upcoming stops, exiting instructions, and other connecting transportation information.

Train separation is maintained by operator surveillance and conventional block lights. However, an automatic electronic separation system exists as a backup to insure maximum safe distances are maintained regardless of operator or block light functioning. The simplified operator's console with visual monitors guarding 33 operating factors allow operator training to be performed in a few weeks. Interlock systems on each train prevent inadvertent operation when a potential malfunction is detected.



TYPICAL MODULAR CAR DESIGNS





Community Applications

Walt Disney monorail systems offer significant benefits to communities seeking modern solutions to the problems of traffic congestion, air pollution, and fuel conservation. Operating over existing freeway medians, versions of the MARK IV Monorail can easily eliminate tens-of-thousands of would-be drivers and place them in the quiet air-conditioned comfort of a swiftly moving electric monorail train. Commuting by monorail will not only alleviate traffic congestion but will also greatly reduce the release of automotive pollutants into the air. The per passenger energy efficiency of the MARK IV Monorail is over five times that of the automobile, and significant fuel savings can result as rising fuel costs become a more important consideration.

Benefits of the monorail system are more than monetary. Because the unique elevated beamway needs less horizontal clearance than traditional road and rail systems, the acquisition of additional right-of-ways is seldom needed. Valuable land representing the City's tax base is not consumed by wide strips of asphalt or concrete. Likewise, the maintenance costs of a narrow concrete monorail beam are significantly less on a per mile basis than that of freeway or subway track. Public transportation budgets today need these factors working for the taxpayers and the commuter patrons.

Community Transportation Services now offers its Modular Car Design to accommodate the specific needs of a particular commuter system. The Modular Car Design permits an economical configuration of a monorail train tailored to the performance requirements of the operator without sacrificing the time-proven control and propulsion systems. The foundation of this design is a basic monorail chassis to which a separate body unit is attached. Flexibility in the body design is possible by utilizing three subcomponents: a midsection and two end sections. The dimensions of the various size car cross-sections are such that all curved panels can be produced on one autoclave tool, keeping manufacturing costs down. Interior seating and sliding doors can also be arranged in various configurations. Overall, the Modular Car Design provides a very flexible approach to adapting the basic MARK IV Monorail for public use, while maintaining economies in production and proven technology.

High speed monorails offer many other advantages to communities seeking innovative ways of solving the problem of public transportation. The environmental and economic benefits associated with the WALT DISNEY family of monorails truly make them a transportation system of the future — here today.

Monorail System Summary

SYSTEM PERFORMANCE

CAPACITY: 10 000 per hour

MAXIMUM WAIT TIME 2 minutes

HEADWAYS: 90 seconds

DWELL TIMES 45 to 90 seconds

RELIABILITY

TOTAL SYSTEM 99 985%

TRAINS (10) 99 982%
(Oct. '78 - Sept. 79)

1979 OPERATING PROFILE

SYSTEM OPERATING HOURS 6 011

SYSTEM DOWNTIME:

Loss of Power	0 hrs. 40 minutes
Weather	0 hrs. 13 minutes
Total	0 hrs. 53 minutes

TRAIN OPERATING HOURS: 40,558

TRAIN DOWNTIME (10 TRAINS):

Mechanical	10 hrs. 28 minutes
Electrical	5 hrs. 1 minute
Total	15 hrs. 29 minutes

TRAIN PERFORMANCE

GRADE: 6%

ACCELERATION 7 ft/sec²

DECELERATION. 3 ft/sec²

DIRECTION: Reversible

ENERGY CONSUMPTION

TOTAL SYSTEM PER YEAR:	5,596 880 KWH
PER TRAIN OPERATING HOUR:	138 KWH
PER TRAIN MILE:	10 76 KWH
PER PASSENGER MILE:	13 KWH
PER SEAT MILE	.05 KWH

TRAIN DESIGN

LENGTH: 5 cars — 171 feet
6 cars — 201 feet

WIDTH: 8' 10"

HEIGHT: 11' 7"

OPERATING ENVELOPE. 10' x 12' 4"

WEIGHT (lbs.)

	Empty	Gross
5 cars	92,000	122,600
6 cars	108,500	145,100

BODY TYPE: Honeycomb bonded aluminum panels

ENVIRONMENTALS: Heating and Air-conditioning

GUIDANCE: Saddle-type monorail

COMMUNICATIONS: Two-way radio PA with taped narration to passengers

HANDICAP Wheelchair tie-downs

PROPULSION AND BRAKING

MOTORS. 600 VDC 100 HP (8 per train)

CONTROLS: Manual, synchronized drive, cam controlled

BRAKING: Dynamic and hydraulic disc

POWER COLLECTION. Replaceable carbon shoes (8 per train)

BEAMWAY

LENGTH. 6.7 miles (10 8 km)

TYPE: Elevated, prestressed and post-tensioned concrete

COLUMNS Tapered concrete up to 65 feet

SPANS. 40' to 110'

RADII. Horizontal — 500 feet
Vertical — 1000 feet

SWITCHES

NUMBER: 7

TYPE: Pivot

LOCK-TO-LOCK: 50 seconds

STATIONS

NUMBER 4

TYPE: On-line

BOARDING Through-loading by designated destination

DWELL: Express 45 seconds
Local 90 seconds

SAFETY

TRAIN SEPARATION 2 manual systems with automatic override monitor

DOORS Interlocks for closed position

OPERATING COSTS*

Oct 1, 1978 - Sept 30, 1979

	1979 Dollars	Per Train Mile (519,370 Miles)	Per Passenger Mile (44,100,000 Miles)
MAINTENANCE	$ 1,007 000	$ 1 93	$ 02
OPERATING	1,268 000	2 46	03
ENERGY	286,000	55	01
TOTAL O. & M.	$ 2,561,000	$ 4.94 PTM	$ .06 PPM

* These are 1978 operating costs experienced at the WALT DISNEY WORLD Resort Complex and due to numerous variables (labor rates, electric rates, passenger densities, etc.) they may vary significantly in different applications.

Community Transportation Services

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